NGINX Conf 2018

The official event for all things NGINX

NGINX JavaScript in Your Web Server Configuration

Dmitry Volynsev
NGINX, Inc.

Outline

1

2

3

4

5

Outline

1. **History of scripting in NGINX**
2.
3.
4.
5.

Outline

1. History of scripting in NGINX
2. **Project goals**
3.
4.
5.

Outline

1. History of scripting in NGINX
2. Project goals
3. **njs interpreter**
4.
5.

Outline

1. History of scripting in NGINX
2. Project goals
3. njs interpreter
4. **Using njs in NGINX**
5.

Outline

1. History of scripting in NGINX
2. Project goals
3. njs interpreter
4. Using njs in NGINX
5. **Plans for the future and available functionality**

History of scripting in NGINX

Ideal scripting

Ideal scripting

- **Fast**
  - Otherwise you can use much more advanced alternatives like node.js.

Ideal scripting

- **Fast**
  - Otherwise you can use much more advanced alternatives like node.js.
- **Integrate well with asynchronous nature of NGINX**

Ideal scripting

- **Fast**
  - Otherwise you can use much more advanced alternatives like node.js.
- **Integrate well with asynchronous nature of NGINX**
- **Modular**
  - So people who do not need it, can disable it to squeeze out performance.

Ideal scripting

- **Fast**
  - Otherwise you can use much more advanced alternatives like node.js.
- **Integrate well with asynchronous nature of NGINX**
- **Modular**
  - So people who do not need it, can disable it to squeeze out performance.
- **Popular scripting language**
  - To help people to write their scripts faster.

Perl scripting

Perl scripting

- **Existing perl libraries can be used.**

Perl scripting

- Existing perl libraries can be used.
- **Perl code can be embedded into nginx conf file.**

Perl scripting

- Existing perl libraries can be used.
- Perl code can be embedded into nginx conf file.

- No support for non-blocking IO.

Perl scripting

- Existing perl libraries can be used.
- Perl code can be embedded into nginx conf file.
- No support for non-blocking IO.
- Perl interpreter can exit the worker process.

Project goals

Goals

Modern, fast, high level scripting tailored to NGINX runtime.

Goals

Modern, fast, high level scripting tailored to NGINX runtime.

- **Fast and lightweight**
  - njs should not degrade NGINX performance too much.
  - memory/cpu overhead should not be substantial.

Goals

Modern, fast, high level scripting tailored to NGINX runtime.

- **Fast and lightweight**
  - njs should not degrade NGINX performance too much.
  - memory/cpu overhead should not be substantial.
- **Security/Robustness**
  - Each request should be isolated from others.

Goals

Modern, fast, high level scripting tailored to NGINX runtime.

- **Fast and lightweight**
  - njs should not degrade NGINX performance too much.
  - memory/cpu overhead should not be substantial.
- **Security/Robustness**
  - Each request should be isolated from others.
- **Popular scripting language**

Why JavaScript?

Why JavaScript?

- **Modern lingua-franca**
  - So, people can quickly understand it.

Why JavaScript?

- **Modern lingua-franca**
  - So, people can quickly understand it.
- **C-like syntax**
  - Good match for nginx config files.

Why JavaScript?

- **Modern lingua-franca**
  - So, people can quickly understand it.
- **C-like syntax**
  - Good match for nginx config files.
- **Event-driven paradigm is natural for JavaScript.**
  - Good match for NGINX runtime.

Why own interpreter?

Why own interpreter?

- **V8/SpiderMonkey are too heavy to be used inside NGINX.**
  - Sophisticated engines, too much overhead not needed in NGINX.

Why own interpreter?

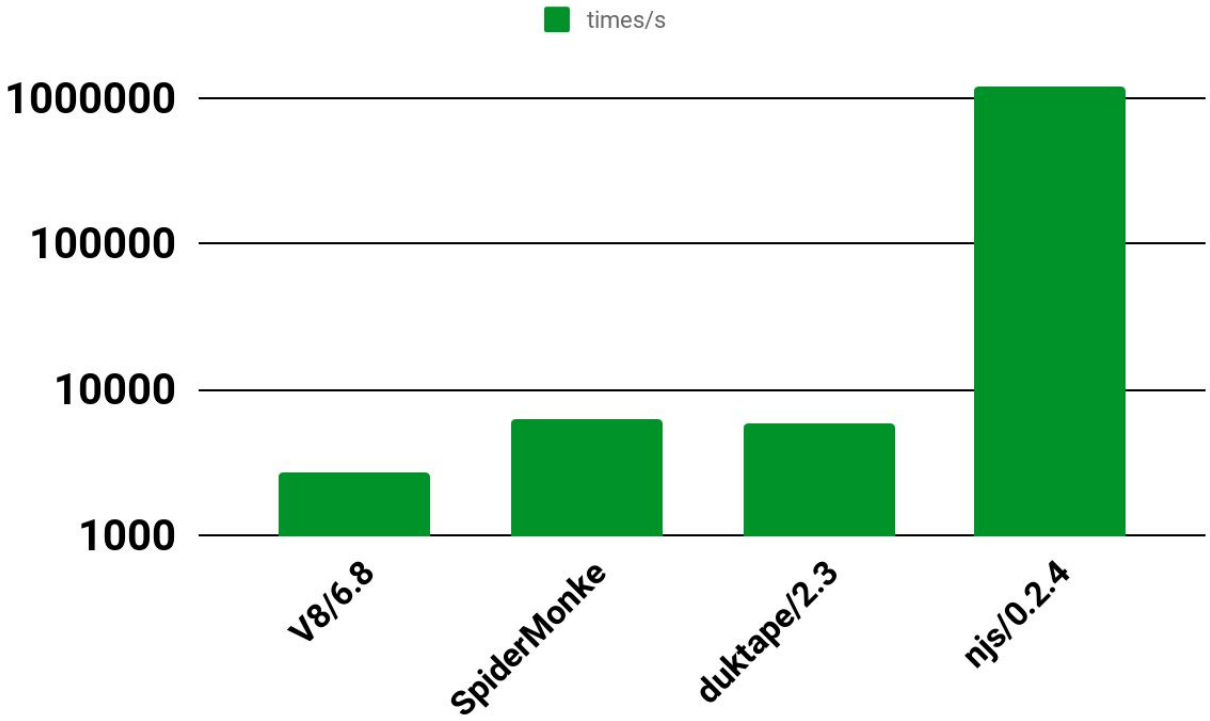
- **V8/SpiderMonkey are too heavy to be used inside NGINX.**
  - Sophisticated engines, too much overhead not needed in NGINX.

- **Duktape is not fast enough for tasks inside NGINX.**
  - Has different sets of priorities. Values memory footprint and ECMAScript specs conformance more than performance.

Why own interpreter?

- **V8/SpiderMonkey are too heavy to be used inside NGINX.**
  - Sophisticated engines, too much overhead not needed in NGINX.
- **Duktape is not fast enough for tasks inside NGINX.**
  - Has different sets of priorities. Values memory footprint and ECMAScript specs conformance more than performance.
- **Custom interpreter can be tailored to NGINX runtime.**

Created contexts/sec



njs interpreter

Why njs is fast?

NGINX modules

Why njs is fast?

NGINX modules

- **Bytecode compilation at start time.**
  - >> 1+1*2
  - 00000 MULTIPLY 1652F30 1652E10 1652F20
  - 00040 ADD 1652F30 1652E10 1652F30
  - 00080 STOP 1652F30

Why njs is fast?

NGINX modules

- **Bytecode compilation at start time.**
  - >> 1+1*2
  - 00000 MULTIPLY 1652F30 1652E10 1652F20
  - 00040 ADD 1652F30 1652E10 1652F30
  - 00080 STOP 1652F30
- **Copy-on-write cloning of compiled VM for each request.**
  - Fast creation and destroying of VMs.

Why njs is fast?

NGINX modules

- **Bytecode compilation at start time.**
  - >> 1+1*2
  - 00000 MULTIPLY 1652F30 1652E10 1652F20
  - 00040 ADD 1652F30 1652E10 1652F30
  - 00080 STOP 1652F30
- **Copy-on-write cloning of compiled VM for each request.**
  - Fast creation and destroying of VMs.
- **No JIT Compilation**

Why njs is fast?

Interpreter

Why njs is fast?

Interpreter

- **Register based VM**
  - Small memory footprint.

Why njs is fast?

Interpreter

- **Register based VM.**
  - Small memory footprint.
- **UTF8 strings, bytes strings optimizations.**
  - ECMAScript specs require UTF-16.

Why njs is fast?

Interpreter

- **Register based VM.**
  - Small memory footprint.
- **UTF8 strings, bytes strings optimizations.**
  - ECMAScript specs require UTF-16.
- **Disabled garbage collection.**
  - Instead cloned VM is destroyed at once.

What njs is not

What njs is not

- **nginx + njs is not an application server.**
  - not “Node.js” replacement

What njs is not

- **nginx + njs is not an application server.**
  - not “Node.js” replacement

- **Strict ECMAScript specs conformance (in progress).**
  - Huge amount of work to do. Pareto principle.

Using njs

Installation

Installation

Adding nginx repo (Ubuntu/16.04)

```
wget http://nginx.org/keys/nginx_signing.key -O nginx_signing.key
sudo apt-key add nginx_signing.key

echo "deb http://nginx.org/packages/mainline/ubuntu/ xenial nginx" | sudo tee
-a /etc/apt/sources.list
```


Installation

Adding nginx repo (Ubuntu/16.04)

```
wget http://nginx.org/keys/nginx_signing.key -O nginx_signing.key
sudo apt-key add nginx_signing.key

echo "deb http://nginx.org/packages/mainline/ubuntu/ xenial nginx" | sudo tee
-a /etc/apt/sources.list
```

Installing package

```
apt-get update
sudo apt-get install nginx nginx-module-njs
```


Installation

Adding nginx repo (Ubuntu/16.04)

```
wget http://nginx.org/keys/nginx_signing.key -O nginx_signing.key
sudo apt-key add nginx_signing.key

echo "deb http://nginx.org/packages/mainline/ubuntu/ xenial nginx" | sudo tee
-a /etc/apt/sources.list
```

Installing package

```
apt-get update
sudo apt-get install nginx nginx-module-njs
```

Examples

https://github.com/xeioex/njs-examples

Hello world

nginx.conf:

```
load_module
modules/ngx_http_js_module.so;
```

Hello world

nginx.conf:

```
load_module
modules/ngx_http_js_module.so;
...
http {
    js_include example.njs;
```


Hello world

nginx.conf:

```
load_module
modules/ngx_http_js_module.so;
...
http {
    js_include example.njs;

    server {
        listen 8000;

        location /hello {
            js_content hello;
        }
...
```


Hello world

nginx.conf:

```
load_module
modules/ngx_http_js_module.so;
...
http {
    js_include example.njs;

    server {
        listen 8000;

        location /hello {
            js_content hello;
        }
...
```

example.njs:

```
function hello(r) {

}
```


Hello world

nginx.conf:

```
load_module
modules/ngx_http_js_module.so;
...
http {
    js_include example.njs;

    server {
        listen 8000;

        location /hello {
            js_content hello;
        }
...
```

example.njs:

```
function hello(r) {
    r.return(200, “Hello world!”);
}
```


Injecting HTTP header

nginx.conf:

```
load_module
modules/ngx_stream_js_module.so;
```


Injecting HTTP header

nginx.conf:

```
load_module
modules/ngx_stream_js_module.so;
...

stream {
    js_include stream.js;









}
```

Injecting HTTP header

nginx.conf:

```
load_module
modules/ngx_stream_js_module.so;
...

stream {
    js_include stream.js;

    server {
        listen 12345;

        proxy_pass 127.0.0.1:8000;
        js_filter  header_inject;
    }
}
```


Injecting HTTP header

nginx.conf:

```
load_module
modules/ngx_stream_js_module.so;
...

stream {
    js_include stream.js;

    server {
        listen 12345;

        proxy_pass 127.0.0.1:8000;
        js_filter  header_inject;
    }
}
```

stream.js:

```
var my_header =  'Foo: foo';

function header_inject(s) {
    var req = '';
    s.on('upload', function(data, flags) {

    });
}
```


Injecting HTTP header

nginx.conf:

```
load_module
modules/ngx_stream_js_module.so;
...

stream {
    js_include stream.js;

    server {
        listen 12345;

        proxy_pass 127.0.0.1:8000;
        js_filter  header_inject;
    }
}
```

stream.js:

```
var my_header =  'Foo: foo';

function header_inject(s) {
    var req = '';
    s.on('upload', function(data, flags) {
        req += data;
        var n = req.search('\n');
        if (n != -1) {

        }
    });
}
```


Injecting HTTP header

nginx.conf:

```
load_module
modules/ngx_stream_js_module.so;
...

stream {
    js_include stream.js;

    server {
        listen 12345;

        proxy_pass 127.0.0.1:8000;
        js_filter  header_inject;
    }
}
```

stream.js:

```
var my_header =  'Foo: foo';

function header_inject(s) {
    var req = '';
    s.on('upload', function(data, flags) {
        req += data;
        var n = req.search('\n');
        if (n != -1) {
            var rest = req.substr(n + 1);
            req = req.substr(0, n + 1);
            s.send(req + my_header + '\r\n' + rest,
                   flags);

        }
    });
}
```


Injecting HTTP header

nginx.conf:

```
load_module
modules/ngx_stream_js_module.so;
...

stream {
    js_include stream.js;

    server {
        listen 12345;

        proxy_pass 127.0.0.1:8000;
        js_filter  header_inject;
    }
}
```

stream.js:

```
var my_header =  'Foo: foo';

function header_inject(s) {
    var req = '';
    s.on('upload', function(data, flags) {
        req += data;
        var n = req.search('\n');
        if (n != -1) {
            var rest = req.substr(n + 1);
            req = req.substr(0, n + 1);
            s.send(req + my_header + '\r\n' + rest,
                   flags);
            s.off('upload');
        }
    });
}
```

Joining subrequests

nginx.conf:

```
location /join {
    js_content join;
}

location /foo {
    proxy_pass http://backend1;
}

location /bar {
    proxy_pass http://backend2;
}
```


Joining subrequests

nginx.conf:

```
location /join {
    js_content join;
}

location /foo {
    proxy_pass http://backend1;
}

location /bar {
    proxy_pass http://backend2;
}
```

example.js:

```
function join(r) {
        join_subrequests(r, ['/foo', '/bar']);
}
```

Joining subrequests

nginx.conf:

```
location /join {
    js_content join;
}

location /foo {
    proxy_pass http://backend1;
}

location /bar {
    proxy_pass http://backend2;
}
```

example.js:

```
function join(r) {
        join_subrequests(r, ['/foo', '/bar']);
}

function join_subrequests(r, subs) {

    for (var i in subs) { r.subrequest(subs[i], done);}
};
```

Joining subrequests

nginx.conf:

```
location /join {
    js_content join;
}

location /foo {
    proxy_pass http://backend1;
}

location /bar {
    proxy_pass http://backend2;
}
```

example.js:

```
function join(r) {
        join_subrequests(r, ['/foo', '/bar']);
}

function join_subrequests(r, subs) {
    var parts = [];

    function done(reply) {
        parts.push({ uri:  reply.uri,
                     body: reply.responseBody });




    }

    for (var i in subs) { r.subrequest(subs[i], done);}
};
```

Joining subrequests

nginx.conf:

```
location /join {
    js_content join;
}

location /foo {
    proxy_pass http://backend1;
}

location /bar {
    proxy_pass http://backend2;
}
```

example.js:

```
function join(r) {
        join_subrequests(r, ['/foo', '/bar']);
}

function join_subrequests(r, subs) {
    var parts = [];

    function done(reply) {
        parts.push({ uri:  reply.uri,
                     body: reply.responseBody });

        if (parts.length == subs.length) {
            r.return(200, JSON.stringify(parts));
        }
    }

    for (var i in subs) { r.subrequest(subs[i], done);}
};
```

Command line

```
docker run -i -t nginx:mainline /usr/bin/njs
```


Command line

```
docker run -i -t nginx:mainline /usr/bin/njs

>> [{a:[Date()]}]
[
 {
  a: 'Sun Sep 23 2018 19:15:17 GMT+0000 (UTC)'
 }
]
```


Command line

```
docker run -i -t nginx:mainline /usr/bin/njs

>> [{a:[Date()]}]
[
  {
    a: 'Sun Sep 23 2018 19:15:17 GMT+0000 (UTC)'
  }
]
>> require('crypto').createHash("sha1").update("XX").digest("hex")
'20026dc165c030fe3a5d9609a6e61ab26210cbc1'
```


Command line

```
docker run -i -t nginx:mainline /usr/bin/njs

>> [{a:[Date()]}]
[
 {
  a: 'Sun Sep 23 2018 19:15:17 GMT+0000 (UTC)'
 }
]
>> require('crypto').createHash("sha1").update("XX").digest("hex")
'20026dc165c030fe3a5d9609a6e61ab26210cbc1'
>> (function(o) {return o.a.a})()
TypeError: cannot get property 'a' of undefined
at anonymous (:1)
at main (native)
```


Available functionality

What is available

- **Object, Array, Number, String, Date, Regexp, Function**
- **JSON, Math**

What is available

- Object, Array, Number, String, Date, Regexp, Function
- JSON, Math
- **exceptions**

What is available

- Object, Array, Number, String, Date, Regexp, Function
- JSON, Math
- exceptions
- **closures, anonymous functions**

What is available

- Object, Array, Number, String, Date, Regexp, Function
- JSON, Math
- exceptions
- closures, anonymous functions
- **crypto, files ops and more**

What is available

- Object, Array, Number, String, Date, Regexp, Function
- JSON, Math
- exceptions
- closures, anonymous functions
- crypto, files ops and more

- eval()

What is available

- Object, Array, Number, String, Date, Regexp, Function
- JSON, Math
- exceptions
- closures, anonymous functions
- crypto, files ops and more

- eval()
- let, const
- arrow functions

What is available

- Object, Array, Number, String, Date, Regexp, Function
- JSON, Math
- exceptions
- closures, anonymous functions
- crypto, files ops and more

- eval()
- let, const
- arrow functions
- modules

Plans

Plans

- **More integration with NGINX**
  - **Embedding njs into NGINX conf files directly.**

Plans

- More integration with NGINX
  - Embedding njs into NGINX conf files directly.
  - **Extending feature set of the modules.**

Plans

- More integration with NGINX
  - Embedding njs into NGINX conf files directly.
  - Extending feature set of the modules.
- **njs development**
  - **Extending ECMAScript specs conformance.**

Plans

- More integration with NGINX
  - Embedding njs into NGINX conf files directly.
  - Extending feature set of the modules.
- njs development
  - Extending ECMAScript specs conformance.
  - **Modules support.**

Thank you

- **Github:** https://github.com/nginx/njs
- **Examples:** https://github.com/xeioex/njs-examples
-

Dmitry Volyntsev
xeioex@nginx.com

Execution model

```
example.njs:
var time = new Date();

function variable_handler(r) {
    return (Date.now() - time).toString();
}

function content_handler(r) {
    r.return(200, “Delay: ” + (Date.now() - time));
}
```


Decode URI

nginx.conf:

```
...
http {
    js_include example.njs;
```

Decode URI

nginx.conf:

```
...
http {
    js_include example.njs;

    js_set $dec_foo dec_foo;
```


Decode URI

nginx.conf:

```
...
http {
    js_include example.njs;

    js_set $dec_foo dec_foo;

    server {
        listen 8000;

        location /dec_foo {
            return 200 $dec_foo;
        }
...
```


Decode URI

nginx.conf:

```
...
http {
    js_include example.njs;

    js_set $dec_foo dec_foo;

    server {
        listen 8000;

        location /dec_foo {
            return 200 $dec_foo;
        }
...
```

example.njs:

```
function dec_foo(r) {
    decodeURIComponent(r.args.foo);
}
```